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Stress Fracture Study Report

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Critical Factors

- Reducing the post-exposure bake temperature to 55 ºC for 2 hours allows for a reduction in the overall stress fracturing of SU-8 masters.

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Goal

Test the effect of a lower temperature post-exposure bake on stress fractures.

Materials

- SU-8 2050
- 3 inch diameter silicon wafers
- Transparency photomasks
- Omega 360 nm long pass filter

Equipment

- Laurell spinner
- Hotplate
- ABM mask aligner
- Zeiss Microscope

Protocol

SU-8 spinning

1. Set spin parameters:
    a. Vacuum = "req"
    b. Step 1 of 2: 500 rpm, accel = "100", 30 sec
    c. Step 2 of 2: 1500 rpm, accel = "300", 30 sec
        i. SU-8 spin curve from data sheet suggests thickness will be 120 µm
2. Positioned and centered wafer
3. Poured SU-8 2025 photoresist without air entrapment to ~ 50 mm diameter
4. Spun the wafer
5. Transferred spun wafer to 65 ºC hot plate for appropriate soft bake time
6. Transferred spun wafer to 95 ºC hot plate for appropriate soft bake time

Resist exposure and development

1. Started the ABM UV lamp (channel A, 365nm). After suitable warmup period, measured bulb exposure power:
    a. Using power meter set to channel A, measured power through transparency, glass blank, and Omega Optical filter
        i. Alternatively, a recent power output value can be found in the power output log located in the ABM Operating Procedure binder
    b. Computed required exposure time based on exposure energy values given on SU-8 data sheets
        i. $Exposure\ time = \frac{Exposure\ energy\ needed}{ABM\ power\ output}$
2. Positioned wafer and photomask
3. Bring into contact with the Omega Optical filter
4. Exposed wafer
5. Post-exposure bake at 65 ºC and then 95 ºC for appropriate bake time or at 55 ºC for 2 hours
6. Developed in bath of SU-8 developer for 5-10 min with periodic agitation
7. Rinsed with acetone and IPA and nitrogen blow-dried

Results

Normal Post-Exposure Bake

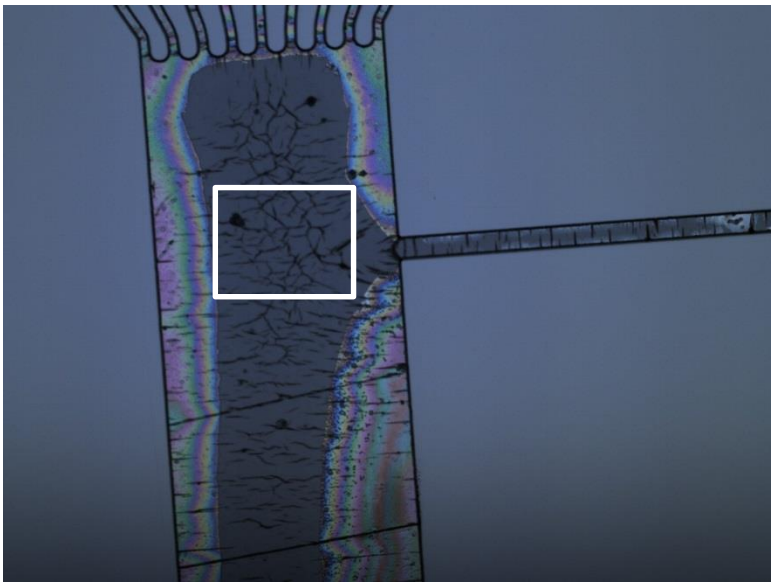

Figure 1: SU-8 master feature using standard PEB per data sheets

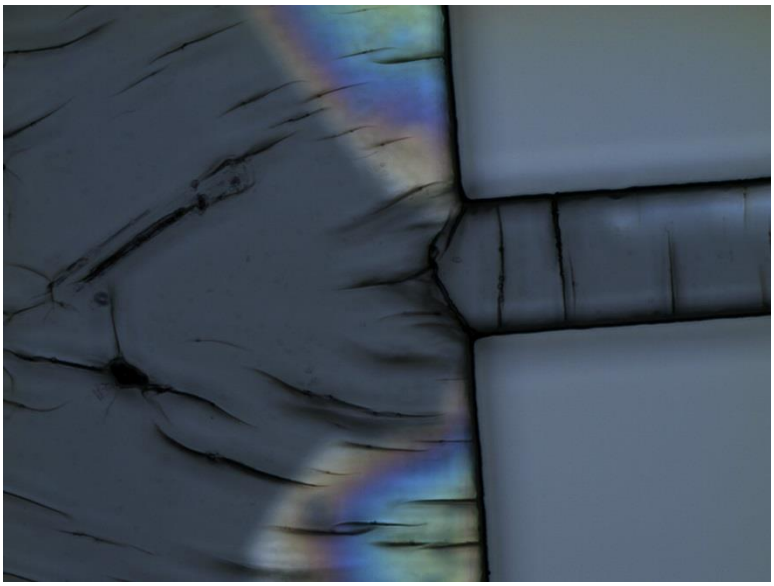

Figure 2: Inset of Figure 1

Reduced Temperature Post-Exposure Bake

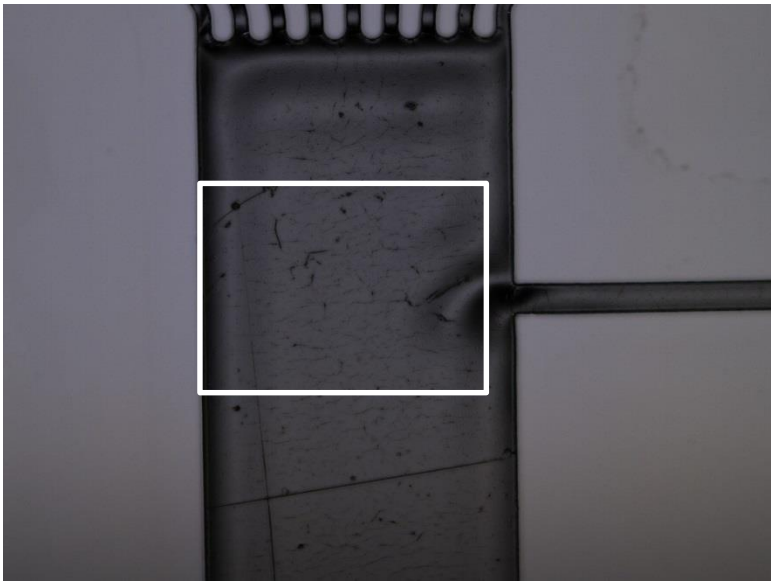

Figure 3: SU-8 feature using PEB temperature of 55 °C for 2 hours

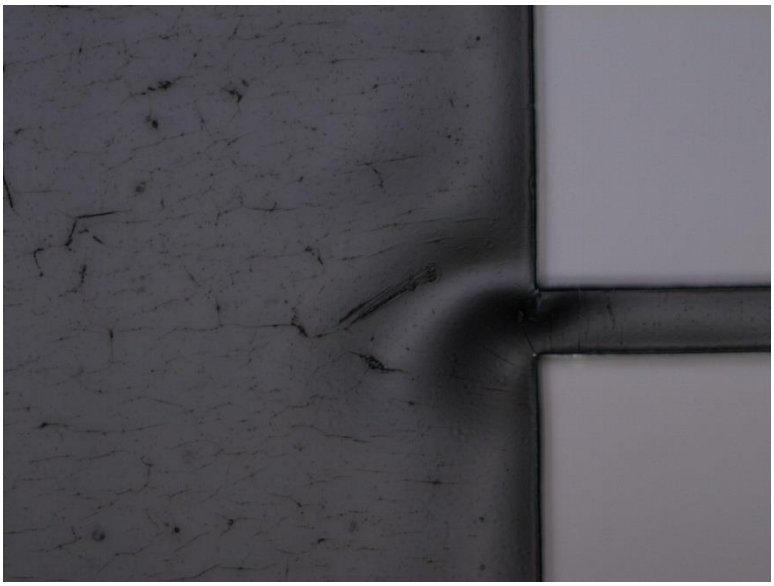

Figure 4: Inset of Figure 3

Comparing the regular PEB temperature against the reduced PEB, it is evident that there is a large reduction in the stress fracturing in the reduced temperature SU-8 master. The downside to using a lower temperature is the increased time required for the PEB step. The time needed for the PEB can still be optimized and tailored more specifically for different thicknesses. Thinner layers are less affected by PEB temperatures.